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Test Report-Anotherm™ vs IMS Substrate in Power LED Applications

Purpose: To evaluate the differences in thermal conductivity between Anotherm™ and IMS substrate when used with a high brightness (Lumiled style) Light Emitting Diode. Thermal Conductivity is an important parameter as the characteristics of modern LEDs are such that higher operating temperatures result in less light output and a shift in the wavelength of light produced (wavelength increases as temperature rises).

Materials: For this evaluation, Lumileds high brightness white LEDs were used. These LEDs were mounted onto a suitable thermally conductive substrate to be evaluated (Anotherm and IMS type). Each thermal substrate was similar in size and bolted to an "infinite heatsink" consisting of a large finned heatsink with air blowing across it. Photos of the test units attached to the heatsink are shown below :

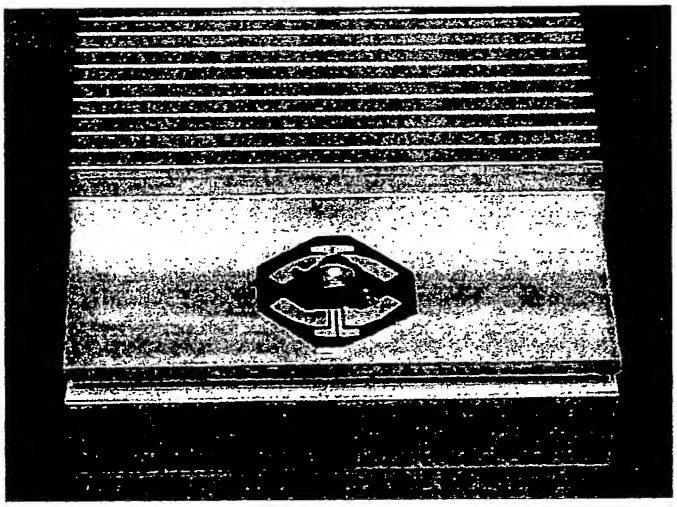


Fig. 1: Anotherm Test Board

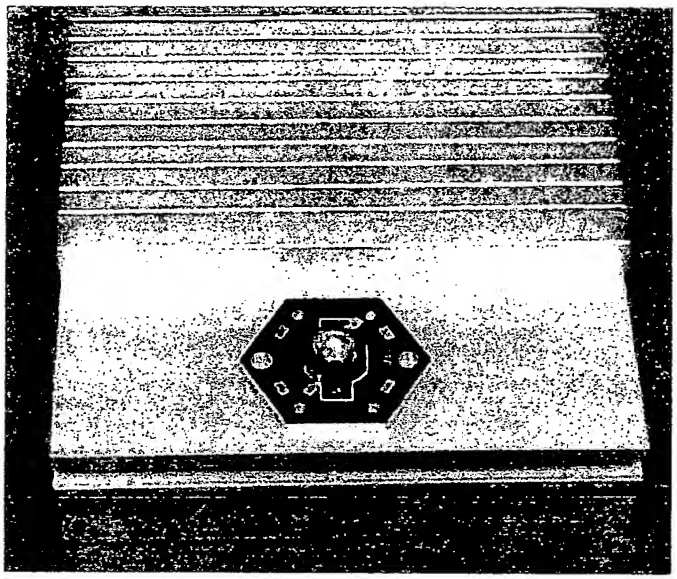


Fig. 2: IMS Test Board

Method: The method used for this test was taken from Appendix 4A of LumiLeds Application Brief AB20-4, "Thermal Management Considerations for SuperFlux LEDs", available from the Lumileds website: www.lumileds.com/pdfs/protected/AB20-4.PDF. This method, in summary, calculates the temperature based on the change in the forward voltage drop across the LED while unpowered, and again after a steady state operating temperature has been achieved. The forward voltage across the LED junction is a constant -2.0mv/°C

Test Results: The calculated temperature results of both substrate types indicate that Anotherm™ substrates offer considerable improvement (25 to 50% reduction) in the temperature rise of the LED junction. Data is shown below:

1 watt LEDs:

	Vf (@23°C, 1ma):	Vf (at 1.36 watts)	ΔVf	Temperature Rise	Junction Temperature
IMS:	2.570	2.528	-0.042v	21°C	44°C
Anotherm™	2.535	2.518	-0.017v	8.5°C	31.5°C

3 watt LEDs

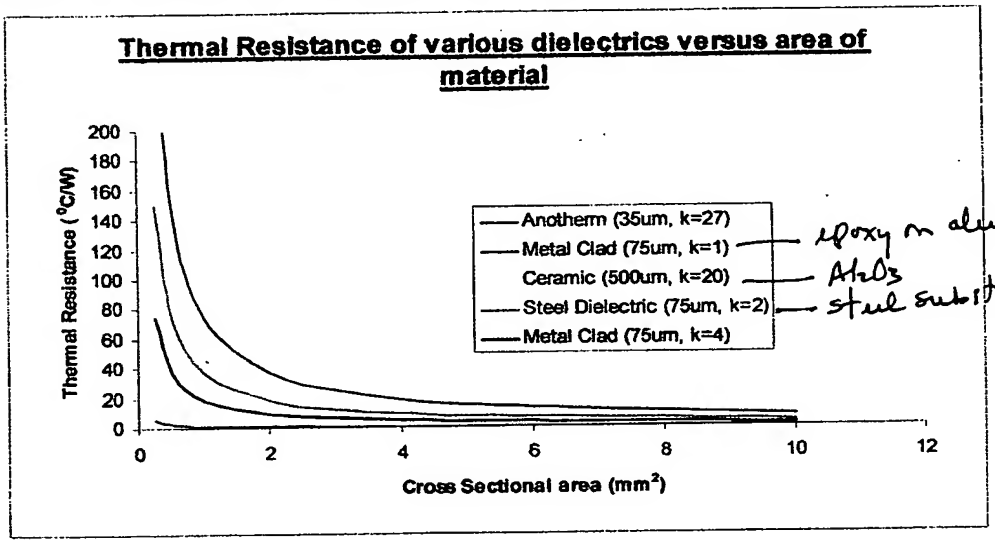
	Vf (@23°C, 1ma):	Vf (at rated)	ΔVf	Temperature Rise	Junction Temperature
IMS:	3.45	3.288	-0.162v	81°C	104°C
Anotherm™	3.44	3.346	-0.094v	47°C	70°C

Conclusion: Anotherm™ Substrates offer a significant improvement in the operating temperature of LEDs. The lower thermal impedance due to the construction process of Anotherm™ allows longer operating life and the potential for driving LEDs harder (to achieve higher light output). The significantly lower thermal impedance is a direct result of the insulating layer on the aluminum substrate being thinner (35 microns typical versus 75 microns minimum for IMS type substrates) and of higher thermal conductivity insulator material. Anotherm uses aluminum oxide (27w/m-°K thermal conductivity) versus filled epoxy (0.9w/m-°K typical) as the dielectric layer between the LED slug and the aluminum board.

T. Morris

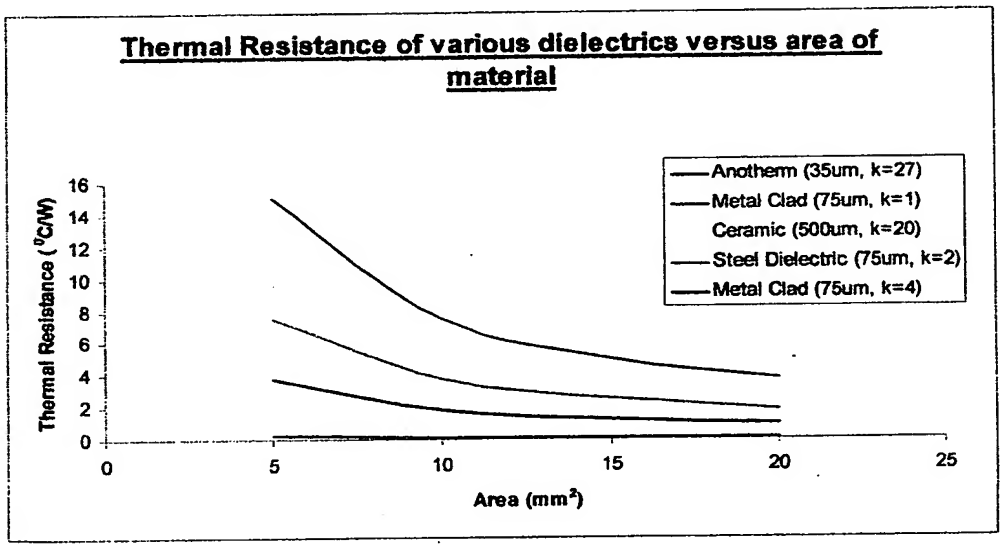
11/15/04

Appendix: Previous testing of Anotherm substrates with a wide range of substrate technologies has been done. The results of these experiments is illustrated below

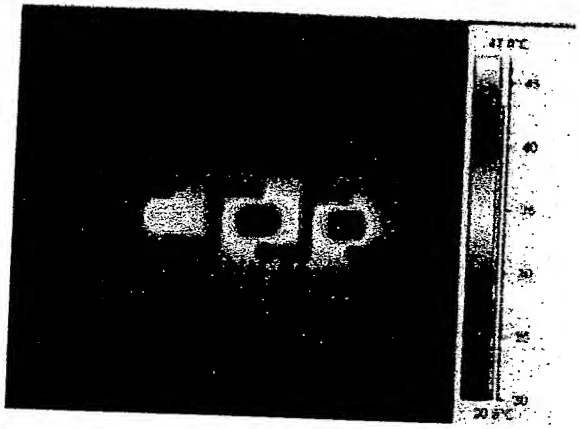


epoxy on aluminum substrate
Al_2O_3
steel substrate w/ epoxy dielectric

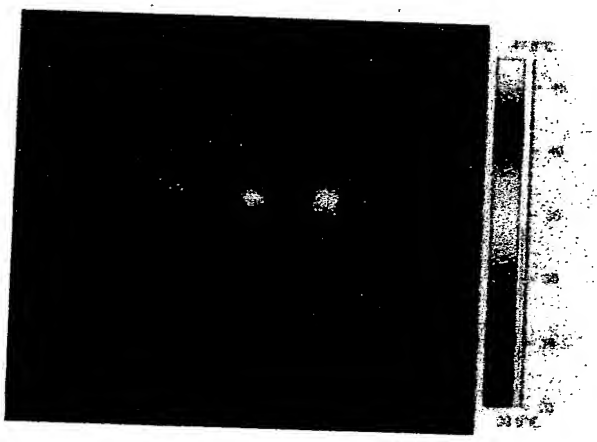
$K = 27 W/m - °K$



Thermal Photograph of Anotherm™ and epoxy insulated metal substrate



Conventional IMS Substrate



Anotherm™ Substrate

3 watt LEDs

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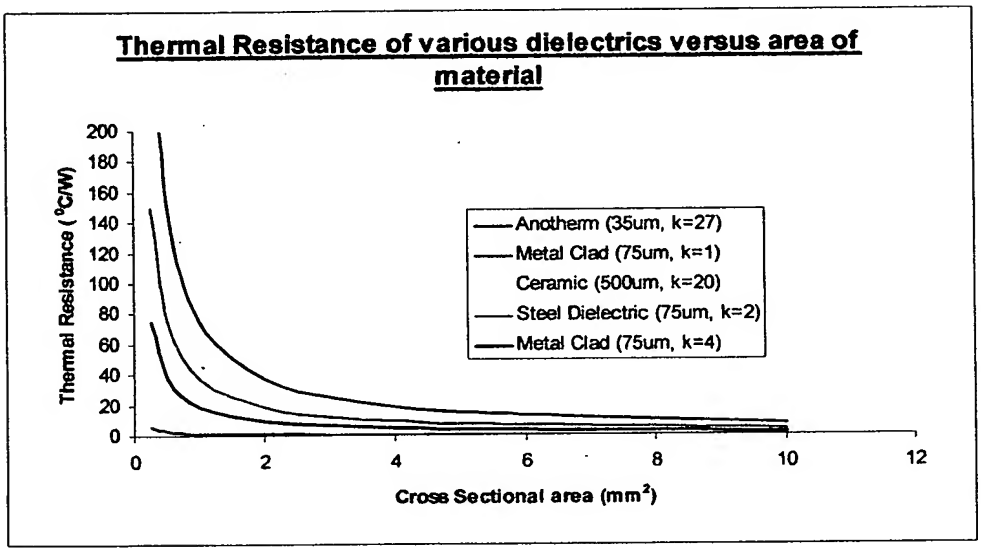
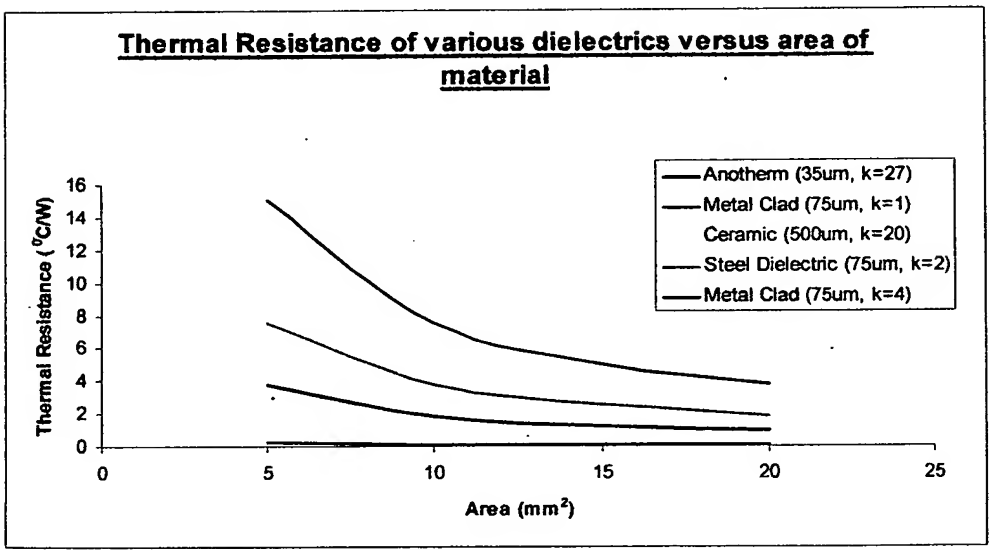
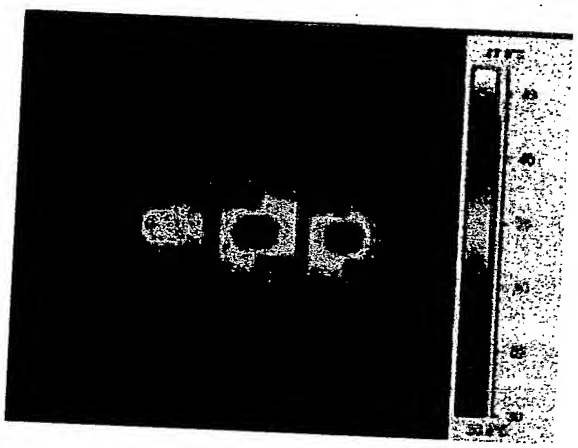
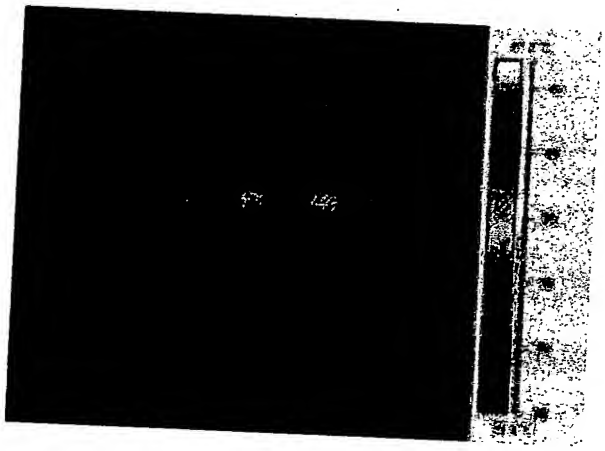




Thermal Photograph of Anotherm™ and epoxy insulated metal substrate



Conventional IMS Substrate



Anotherm™ Substrate